10716

ecology and environment, inc.
International Specialists in the Environment

Cloverleaf Building 3, 6405 Metcalf
Overland Park, Kansas 66202
Tel: (913) 432-9961, Fax: (913) 432-0670

Site: Zykan Landfill
ID #: MOD000157468
Break: 1.6
Other:
5-15-98

May 15, 1998

Evan Kifer
Wellhead Protection Section
P.O. Box 250
Rolla, Missouri 65402

506863
RCRA
A029

Dear Mr. Kifer,

Under the Superfund Technical Assessment and Response Team (START) contract with the U.S. Environmental Protection Agency (EPA), Ecology and Environment, Inc. (E & E), has been tasked to abandon 54 monitoring wells which were installed as part of a site investigation of the Zykan Landfill site in Wright City, Warren County, Missouri (see attached maps: Figures 1 and 2). This is a request for variance on the Missouri Well Construction regulation 10 CSR 23-4.080.

In 1971, Bob's Home Service (BHS), Inc., began operating as a refuse disposal area. The landfill was owned and operated by James Zykan under the title, "BHS Sanitary Landfill." Immediately to the north lies a hazardous waste landfill, BHS Industrial Waste Disposal Facility, which operated from 1977 until 1985 under an interim Resource Conservation and Recovery Act (RCRA) permit. Zykan was also the owner of the hazardous waste landfill. To avoid confusion between the two landfills, BHS Sanitary Landfill is referred to as the Zykan Landfill.

While in operation, several MDNR inspections of the Zykan Landfill revealed unsatisfactory operating practices, including locating fill areas in areas of natural drainage and lack of sufficient cover. In the Zykan Landfill, waste was disposed of in relatively shallow (8-10 feet) trenches. While in operation, the sanitary landfill was to accept municipal solid waste, bulky waste, brush and untreated wood waste. However, in 1972, Zykan expressed interest in accepting industrial chemicals as well. No permit to dispose of such wastes in the Zykan Landfill was granted. However, a letter from the Tretolite Division of Petrolite Corporation in St. Louis, Missouri to the Missouri Department of Health indicates that the sanitary landfill received 30 drums of industrial waste per month. Petrolite describes this waste as "paper

waste, woodscraps, polymers of condensed alanolamines (these should be biodegradable), other chemical wastes such as polyethylene oxide ethers not currently marketable" (Petrolite, 1974).

In 1986, Missouri Department of Natural Resources placed the former BHS Sanitary Landfill (Zykan Landfill) on the registry of Confirmed Abandoned or Uncontrolled Hazardous Waste Disposal Sites in Missouri. Entry was made under the name "Zykan Site" to avoid confusion between BHS Sanitary Landfill and BHS Industrial Waste Disposal Facility. The registry report stated that the industrial wastes accepted by the sanitary landfill was similar to that which was subsequently disposed of in the hazardous waste facility to the north. Waste categories included "toxic pesticides, organic hydrocarbons, inorganic heavy metals, paints, pigments, and trihalomethanes" (MDNR, 1986, MDNR, 1996).

The monitoring wells at the Zykan Site were installed over a period of about 10 years (1977-1987) due to a series of investigations that occurred over that time period. Several different monitoring well designs have been implemented at the site. However, the wells can be classified as belonging to one of five distinct series of monitoring wells (B, GM, GMW, K, and P series). Specific diagrams are attached for B, GM and GMW series wells (see Attachments 1, 2 and 3). The K series wells were bored with 6" hollow-stem augers. The annular space between the screened interval and the total depth was filled with sand. The remainder of the annular space above the sand was filled with a cement-bentonite grout (EPA, 1986). Exact construction details are unknown for the P series wells, but a report by the EPA (1986) states "... it is inferred construction procedures follow that of the initial P series wells (P-1 to P-16)." See Attachment 4 for the generalized well construction for the P series wells. It is unknown if a bentonite plug was used to seal off the space above the sand and it is assumed local (native) soil was used to fill the remainder of the annular space (EPA, 1986). Well construction information for all wells is summarized in Table 1.

An assessment conducted by E & E in March 1998 revealed that 54 of the wells located around the Zykan Landfill were in very poor condition. Several of the B series wells have severely cracked concrete pads. Though the assessed B series wells are equipped with locking steel stick-ups, two of the wells were lacking a well cap. The GM series wells lacked any well cap and no concrete pad was observed around any of the stick-ups. The steel stick-ups were unlocked at the time of the assessment. One GMW well was assessed. It was found to have a steel stick-up and a poured concrete pad, though the stick-up could not be properly locked. (NOTE: The other GMW wells, along with other wells at the site, are currently being used in a RCRA post-closure monitoring plan for the hazardous waste landfill to the north of this site and are not being considered for abandonment.) In the K and P series wells no concrete pads or protective

stick-ups were observed. This lack of protection apparently led to the destruction of some of these wells, as E & E was unable to locate some of the wells and others had broken PVC casings.

The wells are located in the vicinity of known hazardous waste disposal areas. Given this and the initial poor construction of the wells and the poor well maintenance, E & E has concluded that all of the assessed monitoring wells provide a threat to ground water, to varying degrees. Due to the evaluation given by E & E, EPA is requesting the abandonment of the described monitoring wells.

To carry out the abandonment an initial attempt will be made to pull all well casings. E & E is requesting a variance in the abandonment of the monitoring wells in the event that the casings cannot be pulled. The proposed variance for each well will include the following procedures, to be performed by a permitted well installation contractor:

- Soil will be excavated around the well to a depth of three feet below ground surface (BGS).
- The riser pipe will be cut off at three feet BGS.
- A high-solids bentonite slurry-grout, as described in 10 CSR 23-4.060 (11A), will be placed, using a tremie pipe, in the well from the bottom to the top.
- A one-foot thick concrete plug will then be placed on top of the well (from 3' to 2' BGS).
- From 2' BGS to the surface will be backfilled with native soil, compacted, and graded so that water runs away from the well location.

If you have further questions with regard to this request for variance, please contact Bob Overfelt, Patty Currier or myself at (913) 432-9961.

Sincerely,

Ron Ramold
Project Manager

ATTACHMENTS:

1. Maps
2. Table 1: Summary of Wells to be Abandoned
3. Well Construction Diagrams B Series Wells
4. Well Construction Diagrams GM Series Wells
5. Well Construction Diagram GMW Series Well
6. General Well Construction Diagram P Series Wells

REFERENCES

Environmental Protection Agency (EPA), 1986, Update of the Hazardous Waste Ground-Water Task Force Evaluation of the B.H.S., Inc., Wright City, Missouri Facility, December 11, 1986.

Missouri Department of Natural Resources (MDNR), 1986, Confirmed Abandoned or Uncontrolled Hazardous Waste Disposal Sites in Missouri, Annual Report, January 1, 1986.

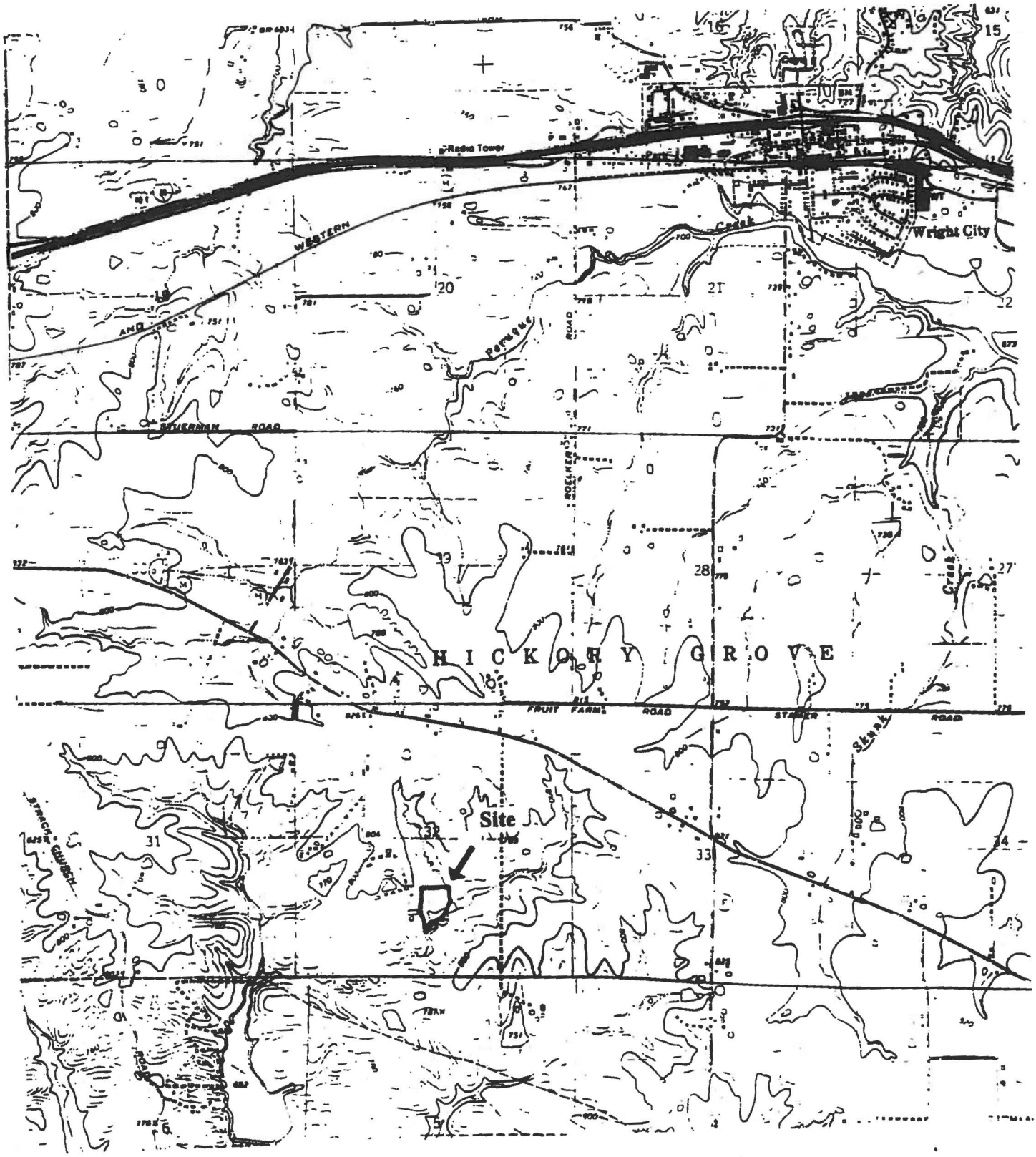
_____, 1996, Confirmed Abandoned or Uncontrolled Hazardous Waste Disposal Sites in Missouri and Hazardous Waste Remedial Fund Statement of Revenue, Expenditures, and Changes in Fund Balance, Fiscal Year 1995 Annual Report, January 1996.

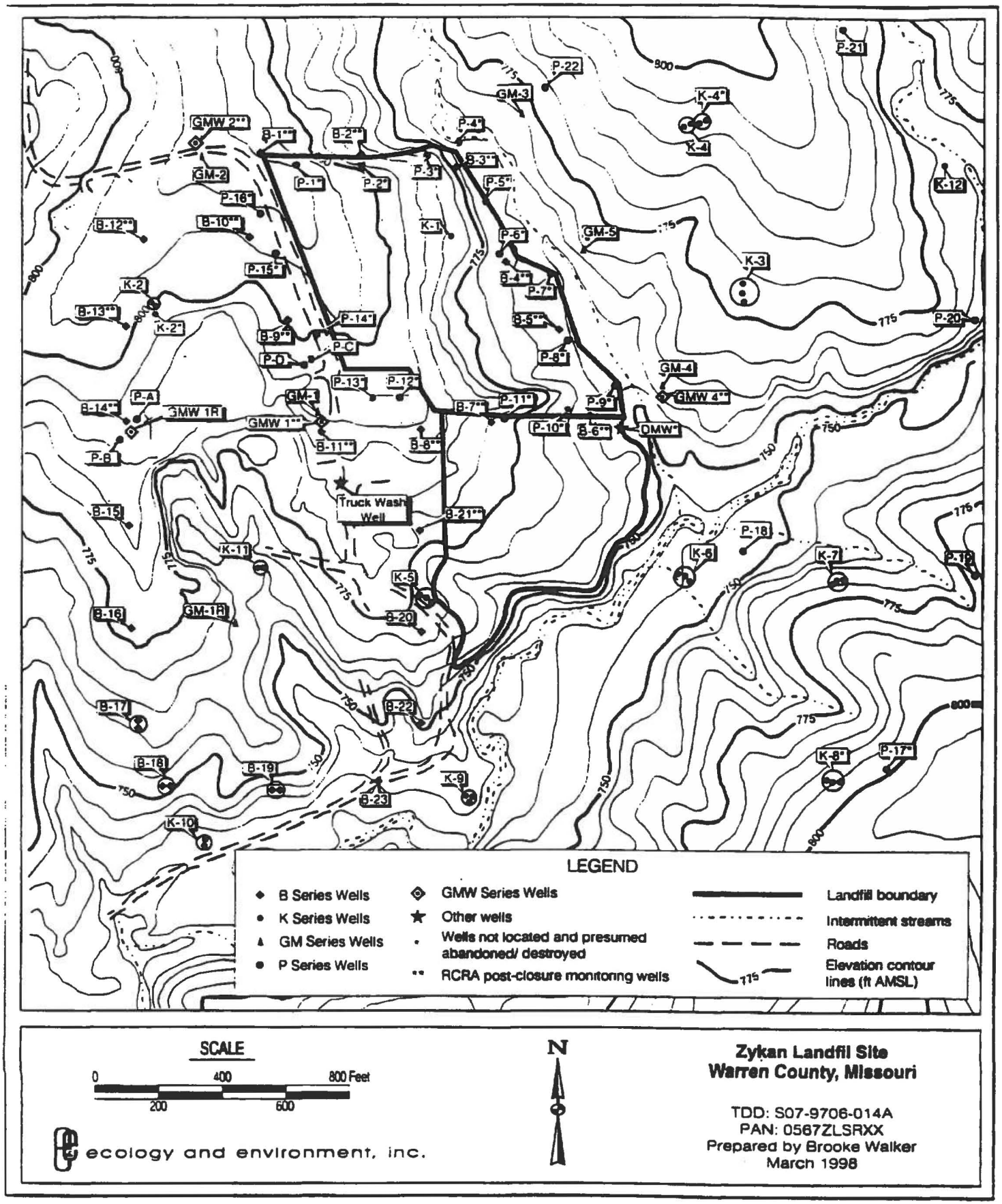
Petrolite Corporation, Tretolite Division, 1974, E.J. Schnieders, Plant Manager, to Barney Bergman, Missouri Department of Health, Letter, April 18, 1974.

ATTACHMENT 1

Maps

Figure 1: Site Location Map





ZYKWELL.CDR

Source: Woodward Clyde (1986) RCRA Part B Application .

Figure 2: Monitoring Well Location Map

ATTACHMENT 2

Table 1: Summary of Wells to be Abandoned

Table 1

MONITORING WELL ASSESSMENT SUMMARY OF WELLS TO BE ABANDONED
ZYKAN LANDFILL SITE—WRIGHT CITY, MISSOURI
FEBRUARY 1998

Monitoring Well	Water Level	Depth of Well		Depth to Top of Screen (reported[c])	Surface Pad (Y/N)	Well Protector (Y/N)	Well Cap (Y/N)	Nominal Casing Diameter (inches) and Material	Borehole Diameter (inches)	Grout	Comments
		Reported[a]	Measured								
B Series											
B-15	38.96	58.89	58.40	48.89	Y	Y	Y	2" S_s	6"	Cement-bentonite grout	Cracked pad.
B-16	28.16	55.71	55.86	45.71	Y	Y	Y	2" S_s			Cracked pad.
B-17A	78.95	80.99	79.85	70.99	Y	Y	N	2" S_s			Cracked pad.
B-17C	25.56	50.44	50.90	40.44	Y	Y	Y	2" S_s			
B-18	19.72	45.86	45.85	35.86	Y	Y	Y	2" S_s			Cracked pad.
B-18A	18.86	30.89	25.20	25.89	Y	Y	Y	2" PVC			Cracked pad.
B-19A	16.21	36.22	35.80	31.22	Y	Y	Y	2" S_s			Cracked pad.
B-19B	17.96	24.72	20.10	14.72	Y	Y	Y	2" PVC			
B-20	23.04	55.86	55.85	45.86	Y	Y	Y	2" S_s			Cracked pad; no padlock.
B-22A	16.90	43.16	40.34	33.16	Y	Y	Y	2" S_s			Cracked pad.
B-23A	2.63	23.43	23.36	13.43	Y	Y	N	2" S_s			Cracked pad.
GM Series Wells											All GM wells constructed with 6" diameter steel well protectors.
GM-1	87.40	126	124.75	95.5	N	Y	N	4" PVC	?	Cement-bentonite grout	
GM-1R	26.01	60.3	57.58	37.3	N	Y	N	4" PVC			Electrical box attached.
GM-2	—	175.8	—	147.3	N	Y	N	4" PVC			Pump in well.
GM-3	dry	125.8	77.20	97.0	N	Y	N	4" PVC			
GM-4	46.10	105.0	83.50	75.7	N	Y	N	4" PVC			
GM Series Wells											
GMW-1R	38.63	104.25[d]	99.18	—	Y	Y	Y	2" S_s	6"	"	Broken well protector lid.
K Series Wells											
K-2 (ox)	36.20	58.9	55.03	56.9	N	N	N	1.5" PVC	? or = 6"	Cement-bentonite grout	
K-2 (80)	69.91	81.20	74.7	61.2	N	N	N	1.5" PVC			
K-3 (ox)	dry	76.35	78.1	66.35	N	N	Y	1.5" PVC			
K-3 (80)	47.21	79.9	76.45	59.9	N	N	Y	1.5" PVC			
K-3 (110)	—	120.8	—	90.8	N	N	Y	1.5" PVC			0.5" PVC within 1.5" PVC prevented depth measurements.
K-3 (br)	—	200.8	—	198.8				0.5" PVC			
K-4 (120)	—	130.2	—	120.2	N	N	Y	1.5" PVC			0.5" PVC within 1.5" PVC prevented depth measurements; reported depth data appears to be in error.
K-4 (br)	—	130.2	—	120.2				0.5" PVC			
K-4 (brr)	76.6	237.1	> 151	212.1	N	N	N	1.5" PVC			
K-5 (ox)	25.12	51.1	47.93	41.1	N	N	Y	1.5" PVC			
K-5 (80)	28.6	81.2	78.6	61.2	N	N	Y	1.5" PVC			
K-5 (sa)	—	106.7	—	96.7	N	N	Y	1.5" PVC			0.5" PVC within 1.5" PVC prevented depth measurements.
K-5 (br)	—	170.7	—	168.7				0.5" PVC			
K-6 (ox)	13.92	22.1	23.45	14.1	N	N	N	1.5" PVC			
K-6 (si)	48.80	124.95	117.20	104.95	N	N	N	1.5" PVC			
K-6 (br)	47.50	180.9	> 151	175.9	N	N	N	1.5" PVC			
K-7 (ox)	dry	44.85	40.75	34.85	N	N	N	1.5" PVC			

Table 1—(Continued)

MONITORING WELL ASSESSMENT SUMMARY OF WELLS TO BE ABANDONED
ZYKAN LANDFILL SITE—WRIGHT CITY, MISSOURI
FEBRUARY 1998

Monitoring Well	Water Level	Depth of Well		Depth to Top of Screen (reported[E])	Surface Pad (Y/N)	Well Protector (Y/N)	Well Cap (Y/N)	Nominal Casing Diameter (inches) and Material	Borehole Diameter (inches)	Grout	Comments
		Reported[E]	Measured								
K Series Wells											
K-7 (si)	91.95	7.7	104.95	-2.3	N	N	N	1.5" PVC	? or = 6"	Cement-bentonite grout	Reported depth data appears to be in error.
K-7 (br)	65.98	195.1	>151	190.1	N	N	N	1.5" PVC			
K-9 (80)	16.47	80.55	69.5	60.55	N	N	N	1.5" PVC			Silt at bottom of well.
K-9 (sa)	35.00	125.2	120.20	115.2	N	N	N	1.5" PVC			
K-9 (br)	24.80	164.2	>151	159.2	N	N	N	1.5" PVC			
K-10 (80)	44.42	82.1	77.10	77.1	N	N	N	1.5" PVC			
K-10 (br)	50.91	80.3	81.55	60.3	N	N	N	1.5" PVC			
K-11 (ox)	9.38	49.9	43.25	39.9	N	N	N	1.5" PVC			0.5" PVC br insert missing from 1.5" PVC ox casing.
K-11 (br)		119.75		99.75	N	N	N	0.5" PVC			
K-11 (sa)	43.22	72.15	54.31	62.15	N	N	N	1.5" PVC			
K-12 (br)	107.55	216.35	>151	214.35	N	N	N	1.5" PVC			
P Series											
P-18	17.62	53.6	53.3	13.6	N	N	N	4" PVC	?	Native soil (assumed)	
P-19	dry	33.8	54.05	-6.5	N	N	Y	4" PVC			Reported depth data appears to be in error.
P-20	15.76	52.7	51.52	12.7	N	N	Y	4" PVC			Large hole in side of casing stickup
P-21	47.75	53.65	54.73	13.65	N	N	Y	4" PVC			
P-22	53.40	52.8	53.40	12.8	N	N	Y	4" PVC			Well almost dry.
P-A	44.25	56.85	59.78	44.85	N	N	N	2" PVC	?	?	8" steel surface casing surrounding PVC stickup and protruding ~ 3" above surface.
P-B	52.5	80.3	80.2	68.3	N	N	Y				
P-C	57.63	84.0	85.25	72.0	N	N	Y				
P-D	25.61	55.0	50.18	43.0	N	N	Y				

KEY: E = Reported in EPA (1986).
J = Reported in Jacobs (1989).

Notes: For located wells, given reported depths incorporate height of stickup measured during site reconnaissance.

K series notation:
- ox = Oxidized/unoxidized glacial till interface.
- 80 = 80 feet in depth.
- sa = Completed in sand layer.
- si = Completed in silty layer.
- 110 = 110 feet in depth.
- br = Bit refusal.
- brr = Bit refusal replacement.

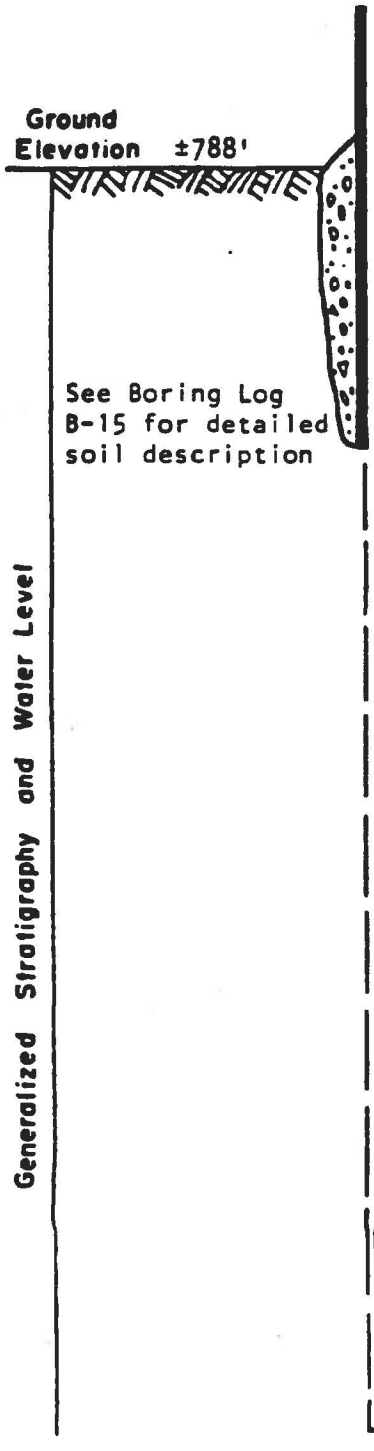
ATTACHMENT 3

Well Construction Diagrams B Series Wells

GROUND WATER OBSERVATION WELL REPORT

PROJECT NAME: BHS, INC.
LOCATION: Wright City, Missouri
Installed by: R. George/B. Bolin **Date:** 11-9-85
Inspected by: D. Bury **Date:** 11-9-85
Method of Installation:
REMARKS:

Piez./Well # 15
Project No. W4C7729
Task No. 6



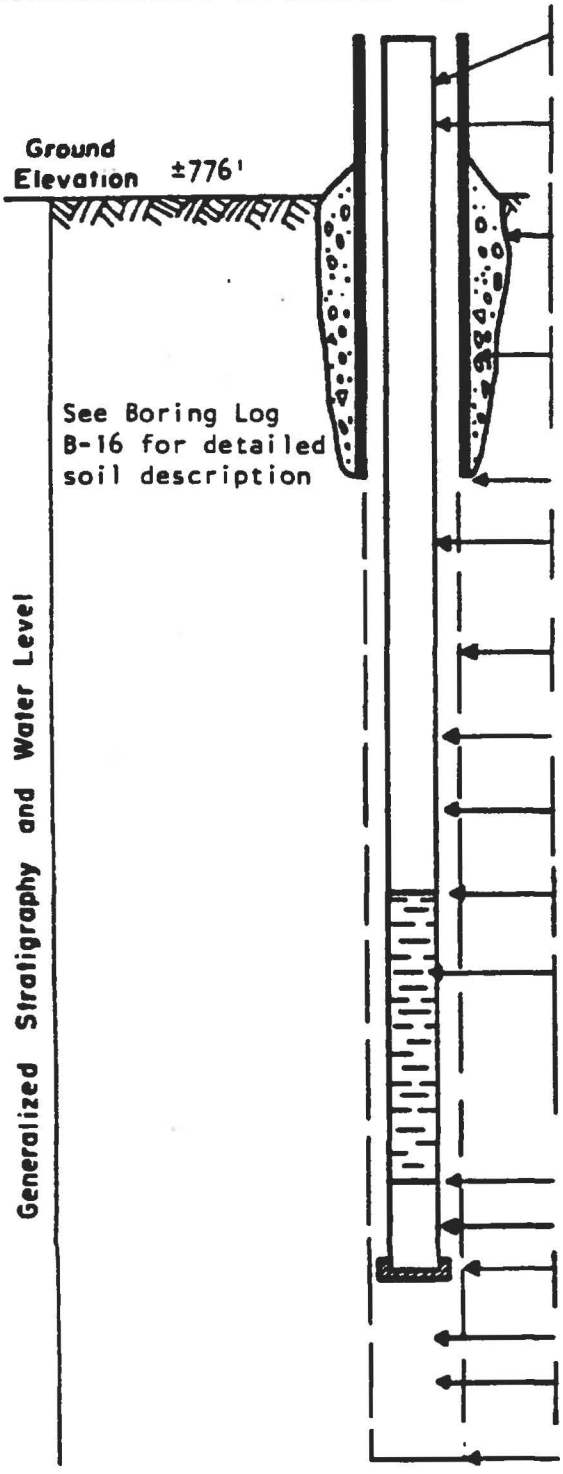
Elevation of top of riser pipe.	791.69'
Height of top of riser pipe above ground surface.	3.83'
Depth of surface seal below ground surface	5"
Type of surface seal: Cement-sand Concrete	
I.D. of surface casing.	4" x 4"
Type of surface casing: Steel	
Depth of surface casing below ground	1.5'
I.D. of riser pipe.	2"
Type of riser pipe: #316 Stainless Steel	
Diameter of borehole	7"
Type of backfill: Cement with 10% bentonite	
Elev./depth top of seal.	756.69
Type of seal: Bentonite pellets	
Elev./depth bottom of seal.	746.69'
Type of sand pack. Fine to medium sand	
Depth of top of sand pack.	746.69'
Elev./depth top of screened section.	743.69'
Type of screened section: #316 S.S.	
Describe openings 0.006"	
I.D. of screened section.	2"
Elev./depth bottom of screened section.	733.69'
Length of blank section.	10"
Elev./depth bottom of plugged blank section.	732.86'
Elev./depth bottom of sand column.	732.86'
Type of backfill below observation pipe. None	
Elev/depth of hole bottom.	732.86'

Woodward-Clyde Consultants

GROUND WATER OBSERVATION WELL REPORT

PROJECT NAME: BHS, INC.
LOCATION: Wright City, Missouri
Installed by: Deka **Date:** 11/9-12/85
Inspected by: B. Billman **Date:** 11/9-12/85
Method of Installation:
REMARKS:

Piez./Well # 16
Project No. W4C7729
Task No. 6

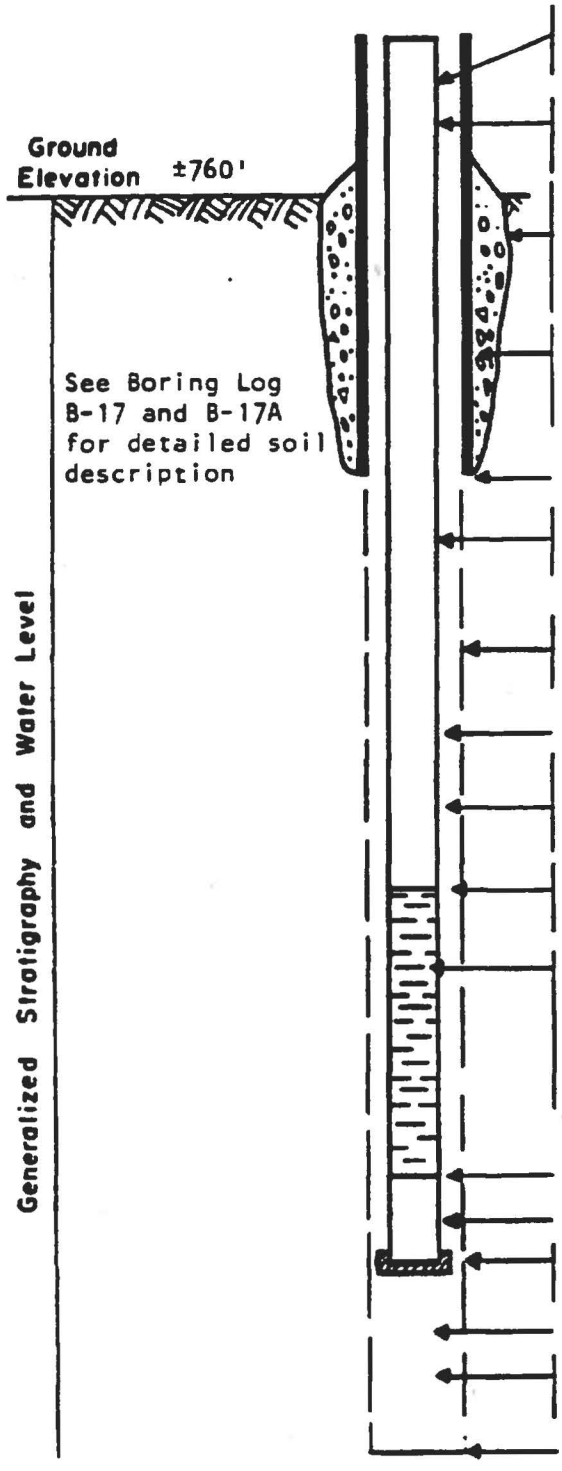


Elevation of top of riser pipe.	776.81'
Height of top of riser pipe above ground surface.	1.5'
Depth of surface seal below ground surface	10.5'
Type of surface seal: Cement-sand Concrete	
I.D. of surface casing.	4" x 4"
Type of surface casing: Steel	
Depth of surface casing below ground	3.21'
I.D. of riser pipe.	2"
Type of riser pipe: #316 Stainless steel	
Diameter of borehole	7"
Type of backfill: Cement-bentonite grout	
Elev./depth top of seal.	737.06'
Type of seal: Bentonite pellets/Granular bent.	
Elev./depth bottom of seal.	733.81'
Type of sand pack: Fine to medium sand	
Depth of top of sand pack.	733.81'
Elev./depth top of screened section.	731.64'
Type of screened section: #316 S.S.	
Describe openings 0.006"	
I.D. of screened section.	2"
Elev./depth bottom of screened section.	721.64'
Length of blank section.	10"
Elev./depth bottom of plugged blank section.	720.81'
Elev./depth bottom of sand column.	720.81'
Type of backfill below observation pipe. None	
Elev./depth of hole bottom.	720.81'

GROUND WATER OBSERVATION WELL REPORT

PROJECT NAME: BHS, INC.
LOCATION: Wright City, Missouri
Installed by: Canonie **Date:** 11/7-8/85
Inspected by: R. Johnson **Date:** 11/7-8/85
Method of Installation:
REMARKS:

Piez./Well # 17A
Project No. W4C7729
Task No. 6

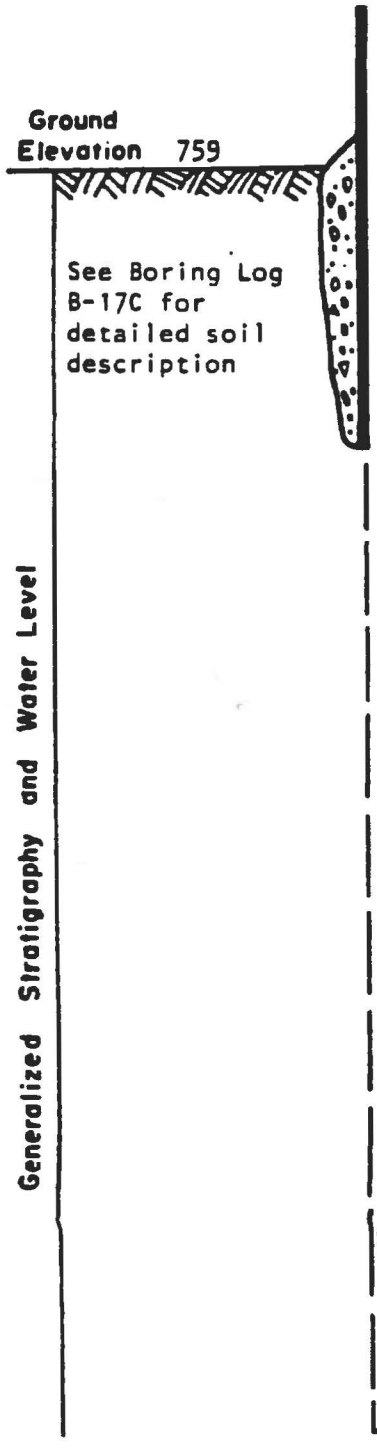


Elevation of top of riser pipe.	762.40'
Height of top of riser pipe above ground surface.	1.96'
Depth of surface seal below ground surface	10.0'
Type of surface seal: Cement-sand Concrete	
I.D. of surface casing.	4" x 4"
Type of surface casing: Steel	
Depth of surface casing below ground	
I.D. of riser pipe.	2"
Type of riser pipe: #316 Stainless steel	
Diameter of borehole	6"
Type of backfill: Cement-bentonie grout	
Elev./depth top of seal.	731.94'
Type of seal: Bentonite pellets/Granular bent.	
Elev./depth bottom of seal.	700.44'
Type of sand pack: Fine to medium sand	
Depth of top of sand pack.	697.44'
Elev./depth top of screened section.	692.27'
Type of screened section: #316 S.S.	
Describe openings 0.006"	
I.D. of screened section.	2"
Elev./depth bottom of screened section.	682.27'
Length of blank section.	10"
Elev./depth bottom of plugged blank section.	681.44'
Elev./depth bottom of sand column.	681.44'
Type of backfill below observation pipe. None	
Elev./depth of hole bottom.	681.44'

GROUND WATER OBSERVATION WELL REPORT

PROJECT NAME: BHS, INC.
LOCATION: Wright City, Missouri
Installed by: R. George **Date:** 12-4-85
Inspected by: D. Bury **Date:** 12-4-85
Method of installation:
REMARKS:

Piez./Well # B-17C
Project No. W4C7729
Task No. 6

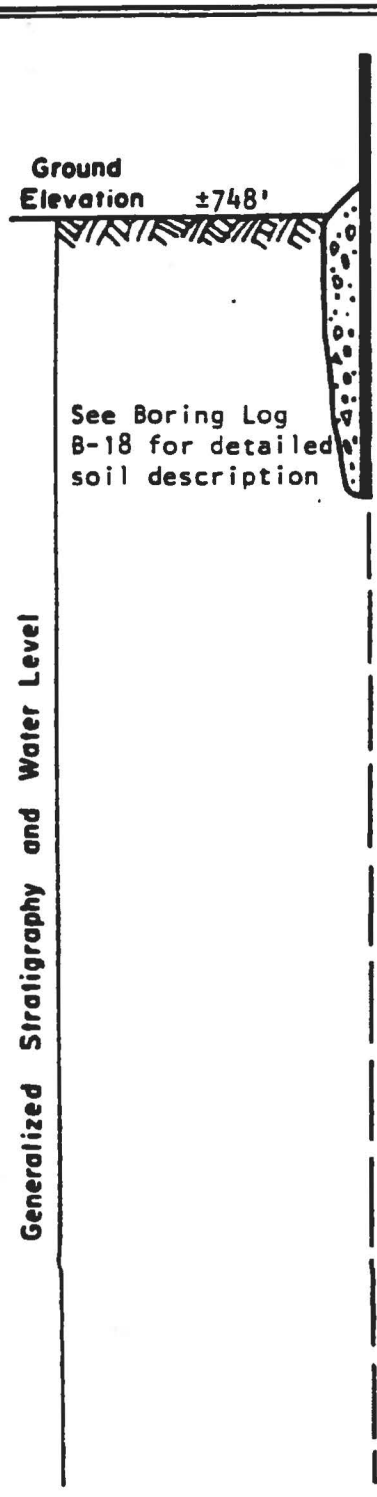


Elevation of top of riser pipe.	762.84'
Height of top of riser pipe above ground surface.	3.83'
Depth of surface seal below ground surface	5"
Type of surface seal: Cement-sand / Concrete	
I.D. of surface casing.	4" x 4"
Type of surface casing: Square steel	
Depth of surface casing below ground	1'
I.D. of riser pipe.	2"
Type of riser pipe: #316 Stainless steel	
Diameter of borehole	7"
Type of backfill: Cement-bentonite slurry	
Elev./depth top of seal.	740.01
Type of seal: Bentonite pellets/bent. slurry	
Elev./depth bottom of seal.	726.01'
Type of sand pack. Fine to medium sand	
Depth of top of sand pack.	726.01'
Elev./depth top of screened section.	722.85'
Type of screened section: #316 S.S.	
Describe openings 0.006"	
I.D. of screened section.	2"
Elev./depth bottom of screened section.	712.85'
Length of blank section.	10"
Elev./depth bottom of plugged blank section.	712.01'
Elev./depth bottom of sand column.	712.01'
Type of backfill below observation pipe. None	
Elev./depth of hole bottom.	712.01'

GROUND WATER OBSERVATION WELL REPORT

PROJECT NAME: BHS, INC.
LOCATION: Wright City, Missouri
Installed by: Deka **Date:** 11-18-85
Inspected by: B. Billman **Date:** 11-18-85
Method of Installation:
REMARKS:

Piez./Well # 18
Project No. W4C7729
Task No. 6

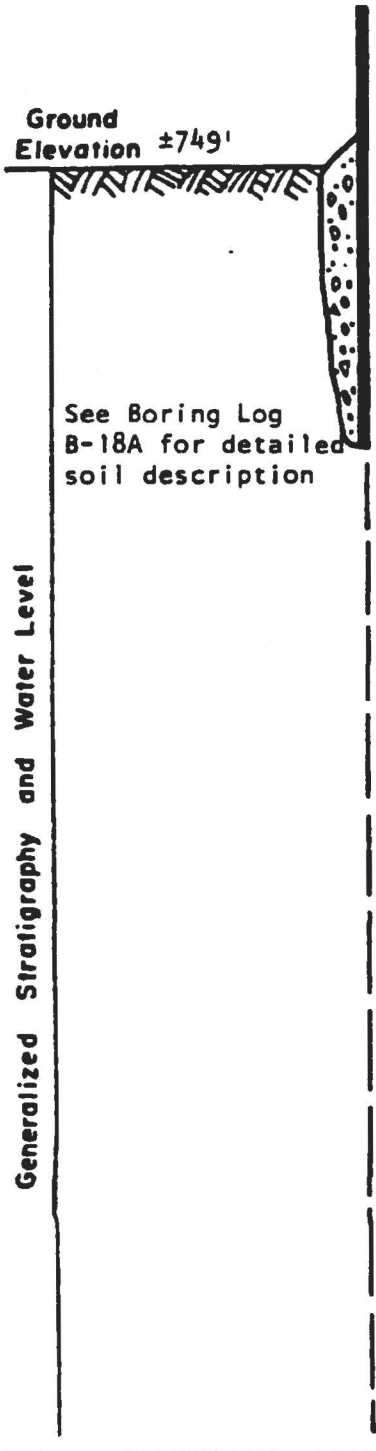


Elevation of top of riser pipe.	750.23'
Height of top of riser pipe above ground surface.	2.0'
Depth of surface seal below ground surface	8.3'
Type of surface seal: Cement-sand Concrete	
I.D. of surface casing.	4" x 4"
Type of surface casing: Steel	
Depth of surface casing below ground	2.5'
I.D. of riser pipe.	2"
Type of riser pipe: #316 Stainless Steel	
Diameter of borehole	7"
Type of backfill: Bentonite cement	
Elev./[illegible] top of seal.	720.56'
Type of seal: Bentonite pellets/Granular bent.	
Elev./[illegible] bottom of seal.	718.23'
Type of sand pack. Fine to medium sand	
Depth of top of sand pack.	718.23'
Elev./[illegible] top of screened section.	715.23'
Type of screened section: #316 S.S.	
Describe openings 0.006"	
I.D. of screened section.	2"
Elev./[illegible] bottom of screened section.	705.23'
Length of blank section.	10"
Elev./[illegible] bottom of plugged blank section.	704.40'
Elev./[illegible] bottom of sand column.	704.40'
Type of backfill below observation pipe. None	
Elev /[illegible] of hole bottom.	704.40'

GROUND WATER OBSERVATION WELL REPORT

PROJECT NAME: BHS, INC.
LOCATION: Wright City, Missouri
Installed by: Deka **Date:** 11-1-9-85
Inspected by: B. Billman **Date:** 11-19-85
Method of Installation:
REMARKS:

Piez./Well # 18A
Project No. W4C7729
Task No. 6

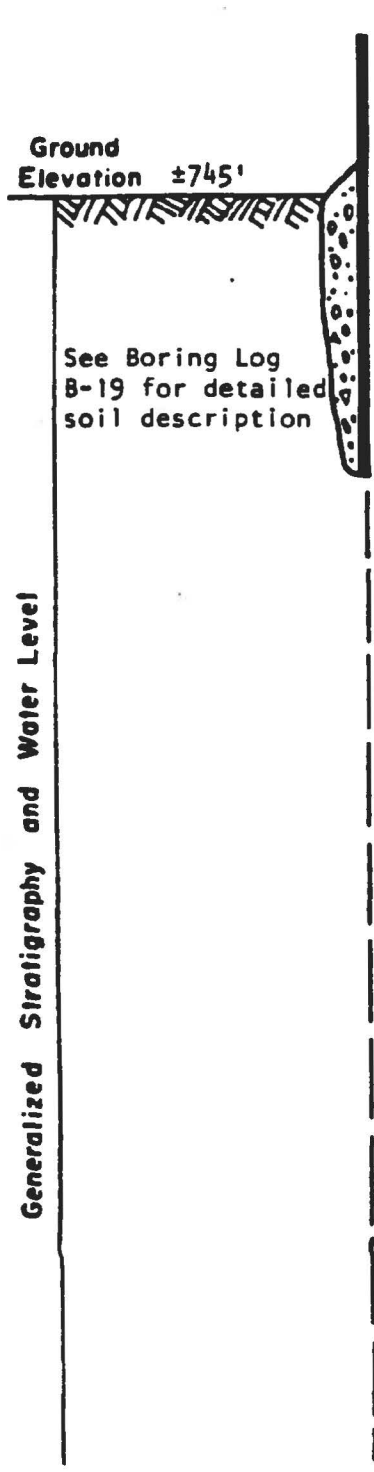


Elevation of top of riser pipe.	749.66'
Height of top of riser pipe above ground surface.	1.33'
Depth of surface seal below ground surface	10.0'
Type of surface seal: Cement-sand Concrete	
I.D. of surface casing.	4" x 4"
Type of surface casing: Steel	
Depth of surface casing below ground	3.5'
I.D. of riser pipe.	2"
Type of riser pipe: Schedule 40 PVC	
Diameter of borehole	7"
Type of backfill: Cement-bentonite grout	
Elev./depth top of seal.	735.25'
Type of seal: Bentonite pellets/Granular bent.	
Elev./depth bottom of seal.	727.66'
Type of sand pack. Fine to medium sand	
Depth of top of sand pack.	727.66'
Elev./depth top of screened section.	725.83'
Type of screened section: Schedule 40 PVC	
Describe openings 0.01"	
I.D. of screened section.	2"
Elev./depth bottom of screened section.	720.83'
Length of blank section.	10"
Elev./depth bottom of plugged blank section.	719.83'
Elev./depth bottom of sand column.	718.50'
Type of backfill below observation pipe. Fine to medium sand	
Elev./depth of hole bottom.	718.50'

GROUND WATER OBSERVATION WELL REPORT

PROJECT NAME: BHS, INC.
LOCATION: Wright City, Missouri
Installed by: R. George/B. Bolin **Date:** 11-20-85
Inspected by: D. Bury **Date:** 11-20-85
Method of Installation:
REMARKS:

Piez./Well# 19A
Project No. W4C7729
Task No. 6

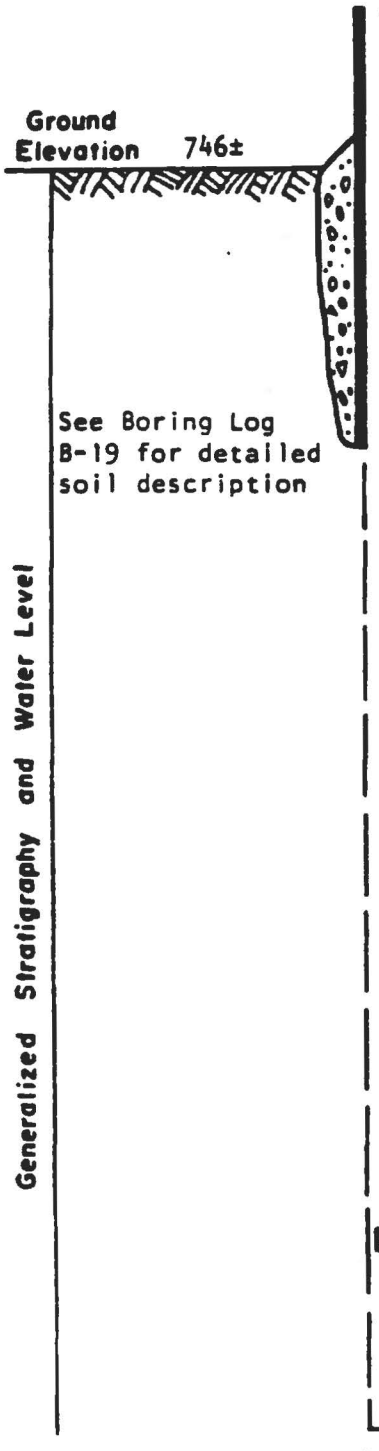


Elevation of top of riser pipe.	746.79'
Height of top of riser pipe above ground surface.	1.25'
Depth of surface seal below ground surface	4.0"
Type of surface seal: Cement-sand Concrete	
I.D. of surface casing.	4" x 4"
Type of surface casing: Steel	
Depth of surface casing below ground	3.67'
I.D. of riser pipe.	2"
Type of riser pipe: #316 Stainless steel	
Diameter of borehole	7"
Type of backfill: Cement/sand	
Elev./depth top of seal.	735.54'
Type of seal: Bentonite	
Elev./depth bottom of seal.	722.71'
Type of sand pack. Fine to medium sand	
Depth of top of sand pack.	722.71'
Elev./depth top of screened section.	721.54'
Type of screened section: #316 S.S.	
Describe openings 0.006"	
I.D. of screened section.	2"
Elev./depth bottom of screened section.	711.54'
Length of blank section.	10"
Elev./depth bottom of plugged blank section.	710.71'
Elev./depth bottom of sand column.	710.71'
Type of backfill below observation pipe. None	
Elev./depth of hole bottom.	710.71'

GROUND WATER OBSERVATION WELL REPORT

PROJECT NAME: BHS, INC.
LOCATION: Wright City, Missouri
Installed by: R. George/B. Bolin **Date:** 11-21-85
Inspected by: D. Bury **Date:** 11-21-85
Method of installation:
REMARKS:

Piez./Well # 19B
Project No. W4C7729
Task No. 6

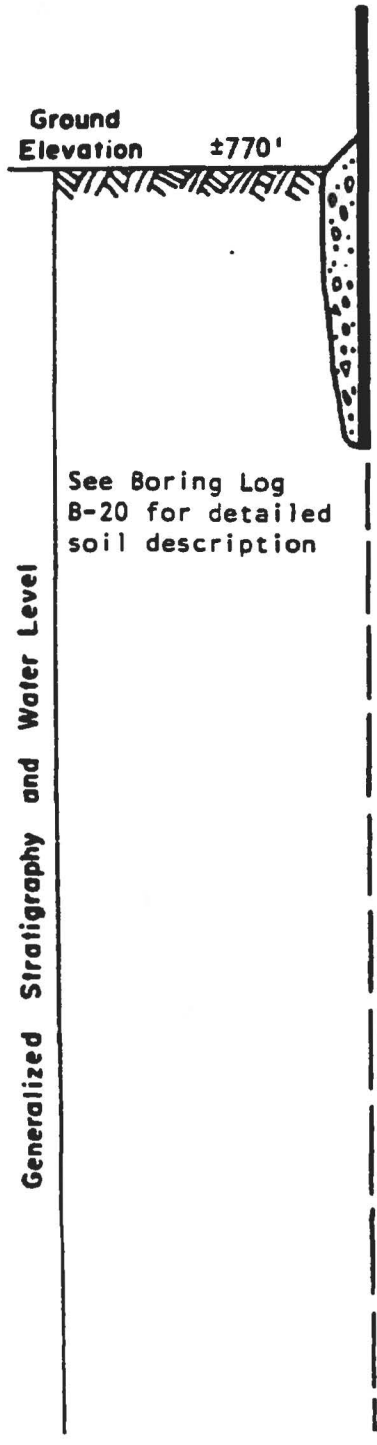


Elevation of top of riser pipe.	748.62'
Height of top of riser pipe above ground surface.	2.5'
Depth of surface seal below ground surface	4.0"
Type of surface seal: Cement-sand Concrete	
I.D. of surface casing.	4" x 4"
Type of surface casing: Square steel	
Depth of surface casing below ground	2.33'
I.D. of riser pipe.	2.0'
Type of riser pipe: Schedule 40 PVC	
Diameter of borehole	7"
Type of backfill: Cement and sand grout	
Elev./depth top of seal.	736.12'
Type of seal: Bentonite pellets/bent. slurry	
Elev./depth bottom of seal.	731.12'
Type of sand pack. Fine to medium sand	
Depth of top of sand pack.	731.12'
Elev./depth top of screened section.	729.04'
Type of screened section: Schedule 40 PVC	
Describe openings 0.010"	
I.D. of screened section.	2.0"
Elev./depth bottom of screened section.	724.04'
Length of blank section.	5"
Elev./depth bottom of plugged blank section.	723.62'
Elev./depth bottom of sand column.	723.62'
Type of backfill below observation pipe. None	
Elev./depth of hole bottom.	723.62'

GROUND WATER OBSERVATION WELL REPORT

PROJECT NAME: BHS, INC.
LOCATION: Wright City, Missouri
Installed by: Deka **Date:** 11-5-85
Inspected by: B. Billman **Date:** 11-5-85
Method of Installation:
REMARKS:

Piez./Well # 20
Project No. W4C7729
Task No. 6

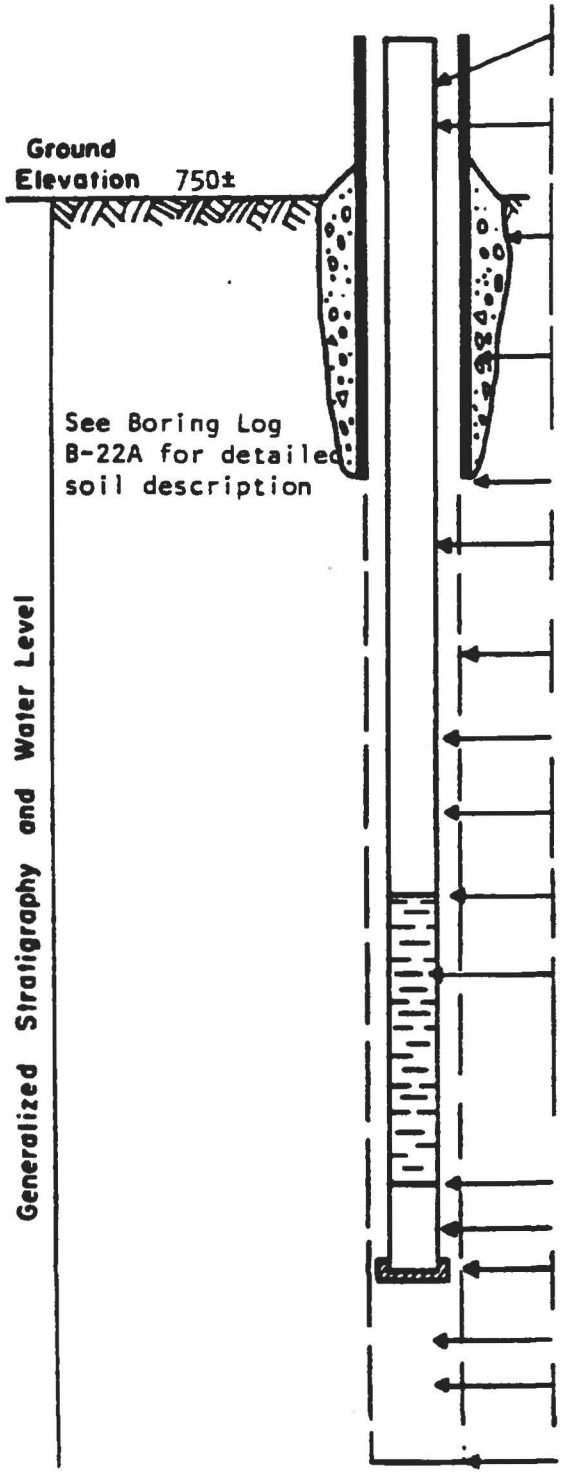


Elevation of top of riser pipe.	771.46'
Height of top of riser pipe above ground surface.	2.3'
Depth of surface seal below ground surface	10.0'
Type of surface seal: Cement-sand Concrete	
I.D. of surface casing.	4" x 4"
Type of surface casing: Steel	
Depth of surface casing below ground	2.7'
I.D. of riser pipe.	2"
Type of riser pipe: #316 Stainless steel	
Diameter of borehole	7"
Type of backfill: Cement/Bentonite grout	
Elev./[illegible] top of seal.	747.91'
Type of seal: Bentonite pellets/granular bent.	
Elev./[illegible] bottom of seal.	729.16'
Type of sand pack: Fine to medium sand	
Depth of top of sand pack.	729.16'
Elev./[illegible] top of screened section.	726.00'
Type of screened section: #316 S.S.	
Describe openings 0.006"	
I.D. of screened section.	2"
Elev./[illegible] bottom of screened section.	716.00'
Length of blank section.	10"
Elev./[illegible] bottom of plugged blank section.	715.33'
Elev./[illegible] bottom of sand column.	715.16'
Type of backfill below observation pipe. None	
Elev./[illegible] of hole bottom.	715.16'

GROUND WATER OBSERVATION WELL REPORT

PROJECT NAME: BHS, INC.
LOCATION: Wright City, Missouri
Installed by: Deka **Date:** 12-5-85
Inspected by: K. Flory **Date:** 12-5-85
Method of Installation:
REMARKS:

Piez./Well # 22A
Project No. W4C7729
Task No. 6

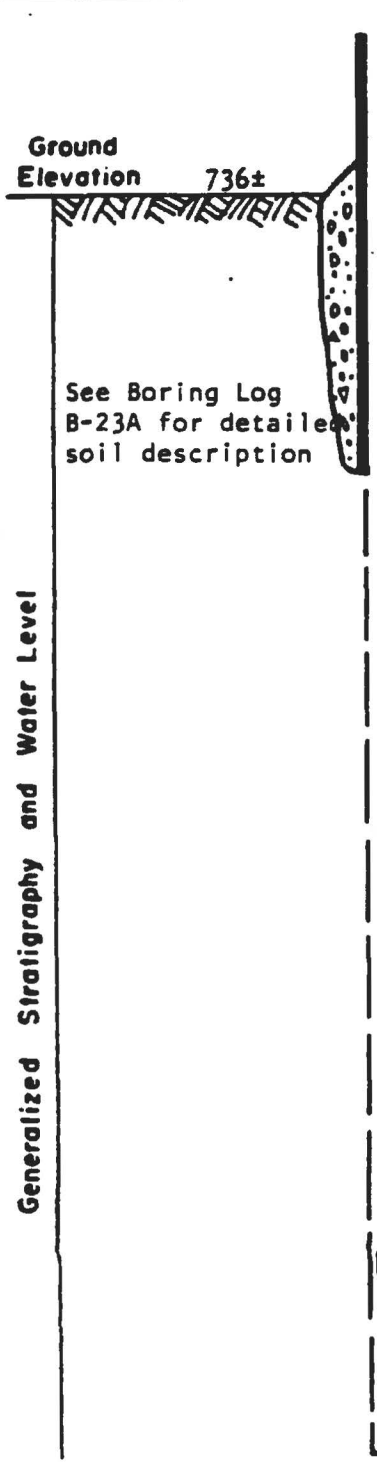


Elevation of top of riser pipe.	752.66'
Height of top of riser pipe above ground surface.	2.33'
Depth of surface seal below ground surface	12'
Type of surface seal: Cement-sand Concrete	
I.D. of surface casing.	4" x 4"
Type of surface casing: Square steel	
Depth of surface casing below ground	2.66'
I.D. of riser pipe.	2"
Type of riser pipe: #316 Stainless steel	
Diameter of borehole	7"
Type of backfill: cement/betintie slurry	
Elev./[illegible] top of seal.	732.33'
Type of seal: Bentonite pellets/Bent. slurry	
Elev./[illegible] bottom of seal.	722.33'
Type of sand pack. Fine to medium sand	
Depth of top of sand pack.	722.33'
Elev./[illegible] top of screened section.	720.17'
Type of screened section: #316 S.S.	
Describe openings 0.006"	
I.D. of screened section.	2"
Elev./[illegible] bottom of screened section.	710.17
Length of blank section.	10"
Elev./[illegible] bottom of plugged blank section.	709.33'
Elev./[illegible] bottom of sand column.	709.33'
Type of backfill below observation pipe. None	
Elev./[illegible] of hole bottom.	709.33'

GROUND WATER OBSERVATION WELL REPORT

PROJECT NAME: BHS, INC.
LOCATION: Wright City, Missouri
Installed by: Deka **Date:** 12-4-85
Inspected by: B. Billman **Date:** 12-4-85
Method of Installation:
REMARKS:

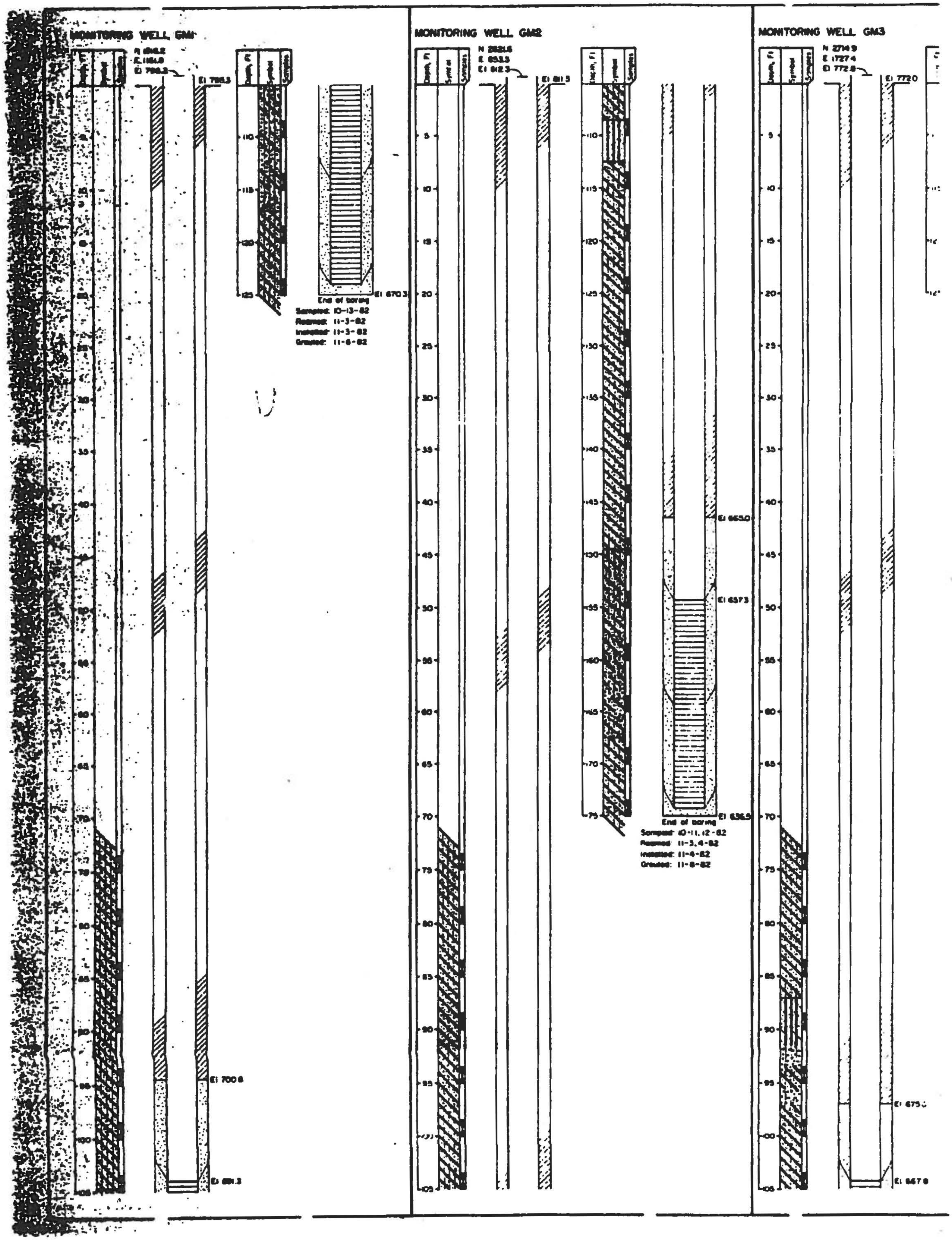
Piez./Well # 23A
Project No. W4C7729
Task No. 6



Elevation of top of riser pipe.	738.85'
Height of top of riser pipe above ground surface.	2.75'
Depth of surface seal below ground surface	3.16'
Type of surface seal: Cement-sand Concrete	
I.D. of surface casing.	4" x 4"
Type of surface casing: Square Steel	
Depth of surface casing below ground	2'
I.D. of riser pipe.	2"
Type of riser pipe: #316 Stainless steel	
Diameter of borehole	7"
Type of backfill: Cement/bentonite slurry	
Elev./depth top of seal.	732.94'
Type of seal: Bentonie pellets/bent. slurry	
Elev./depth bottom of seal.	729.10'
Type of sand pack. Fine to medium sand	
Depth of top of sand pack.	729.10
Elev./depth top of screened section.	726.35'
Type of screened section: #316 S.S.	
Describe openings 0.006"	
I.D. of screened section.	2"
Elev./depth bottom of screened section.	716.35'
Length of blank section.	10"
Elev./depth bottom of plugged blank section.	715.52'
Elev./depth bottom of sand column.	715.52'
Type of backfill below observation pipe. None	
Elev./depth of hole bottom.	715.52'

ATTACHMENT 4

Well Construction Diagrams GM Series Wells



MONITORING WELL GM1
El 670.3
End of boring
Sampled: 10-13-82
Reamed: 11-3-82
Installed: 11-3-82
Grouted: 11-6-82
El 700.8
MONITORING WELL GM2
N 2621.6
Depth, Ft
Symbol
Samples
El 811.5
El 653.0
El 637.3
El 636.5
End of boring
Sampled: 10-11, 12-82
Reamed: 11-3, 4-82
Installed: 11-4-82
Grouted: 11-8-82
MONITORING WELL GM3
N 2714.9
E 1727.4
El 772.8
El 772.0
Depth, Ft
Symbol
Samples

MONITORING WELL GM4
MONITORING WELL GM5
MONITORING WELL GM6R
End of boring
Sampled 10-13, 18-82
Reamed 11-8-82
Installed 11-8-82
Grouted 11-9-82
Sampled 10-14-82
Reamed 11-4, 5-82
Installed 11-5-82
Grouted 11-9-82
Sampled 5-3,4-84
Reamed 5-9-84
Installed 5-11-84
Grouted 5-14-84
Sampled: 5-3-84
Reamed: 5-11-84
Installed 5-11-84
Grouted: 5-14-84
Ground El 7842
Sampled 5-2-84, Grouted 5-14-84
GLACIAL DRIFT
GLACIAL TILL
D.E.Klockow & Associates
Consulting Geotechnical Engineers
5921 Wagon Trail Road, Rt. 14, Columbia, Missouri 65202
314 443-6084
BHS, Inc. Industrial Waste Management Facility
Rt. 1, Box 116-F, Wright City, Missouri 63390
MONITORING WELL INSTALLATION DATA
Job No 84-008
Date 4-16-84

Soil Types

Clay

Clayey

Silt

Silty

Sand

Sandy

Gravel

Gravelly

Inte... [illegible] Constituency

Soil Description

[illegible] with [illegible], [illegible] 5% [illegible], with [illegible] trace [illegible].

INTERBEDDED. Containing alternating layers of different soil types

INTERMIXED. Containing appreciable, random and [illegible] quantities of varying color or texture

LAMINATED. Containing thin and alternating layers of color or texture

MOTTLED. Containing appreciable random specks or pockets of varying color or texture

LAYER. Thickness greater than 3"

SEAM. Thickness ranges from 1/8" to [illegible]

PARTING. Thickness [illegible] than [illegible]

Sampler Types

[illegible] tube ASTM [illegible]

[illegible] split-barrel ASTM [illegible] (1974)

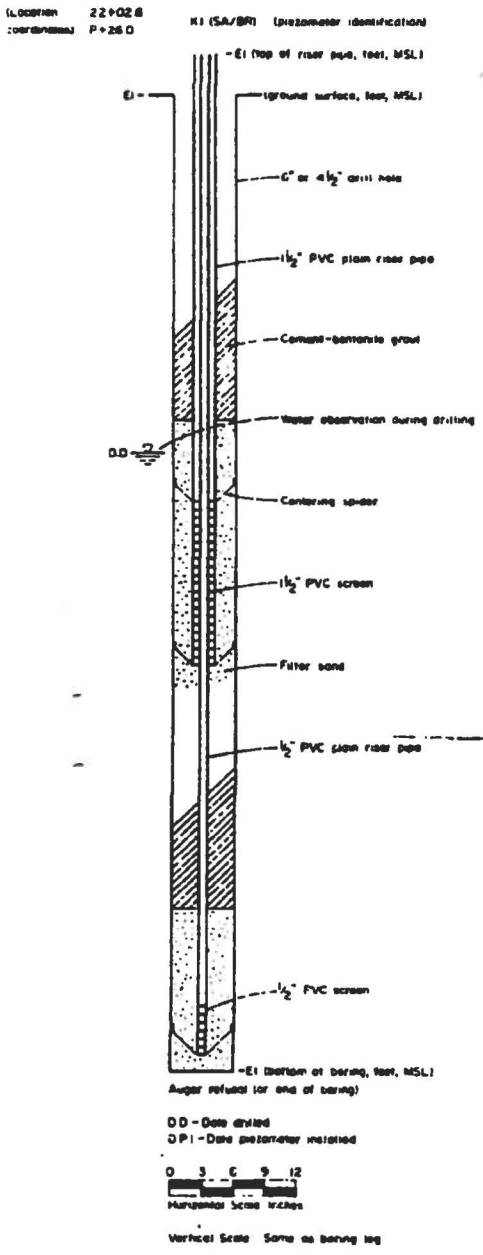
No recovery

Hydraulically pushed, 2" OD, [illegible] split-barrel sampler

Soil Properties

Symbol	Property
N	Standard penetration resistance
[illegible]	[illegible]
NP	Nonplastic
●	Water content
●----●	Plastic [illegible] Limit ... Liquid Limit
●	Cohesion, [illegible]
[illegible]	Cohesion [illegible]
[illegible]	Cohesive [illegible]

LEGEND FOR BORING LOGS



Stratification changes from boring logs

LEGEND FOR PIEZOMETERS AND WELLS

LEGEND FOR

(Boring next identification)

(East-west/north-south coordinate boring location)

Ground surface at boring

CL	Silty Clay
SC	Sandy Clay
SC	Sandy Silty Clay
ML	Silt
SP	Sand
SM	Silty Sand
ML	Sandy Silt
SC	Clayey Silty Sand
SC	Sandy Clayey Silt
SM SC	Interlayered Silty Sand and Sandy Silty Clay

Stratification changes from boring logs

EB-End of boring
AR-Auger refusal

LEGEND FOR GEOLOGIC SECTIONS

ELLS

Revision	Date

D.E.Klockow & Associates
Consulting Geotechnical Engineers
5921 Wagon Trail Road, Rt. 14, Columbia, Missouri 65202
314 443-6084

BHS, Inc. Industrial Waste Management Facility
Rt. 1, Box 116-F, Wright City, Missouri 63390
SYMBOLS & NOTATION USED FOR SUBSURFACE DATA

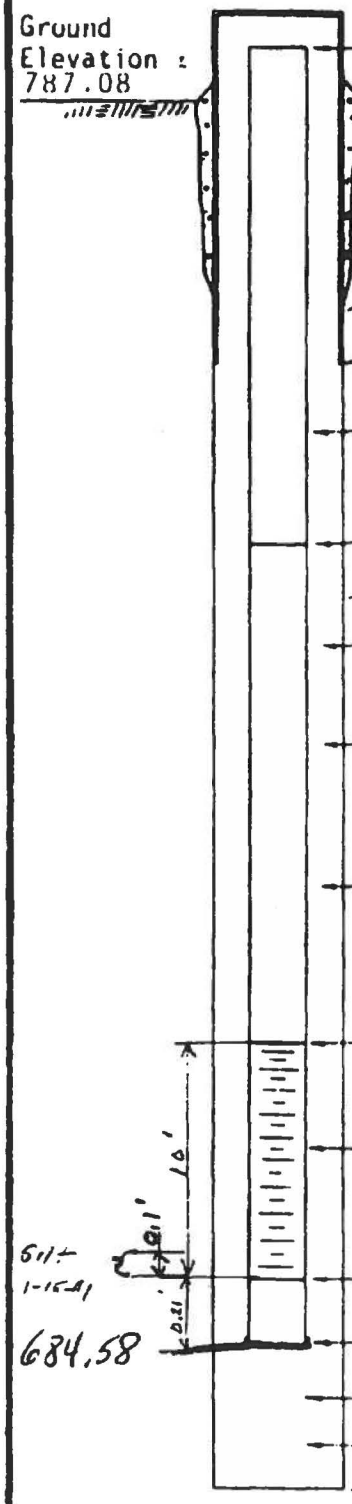
Job No. 8-008
Date 4-20-88

ATTACHMENT 5

Well Construction Diagram GMW Series Well

TOTAL DEPTH = 109.25'

GMW-1R



Height of top of PVC riser pipe above ground surface. 783.83	1.75' 21"
Type of surface seal: Cement-sand concrete.	
Depth of surface seal below ground surface.	Min. 30"
I.D. of surface casing.	4"x4"
Type of surface casing: Steel	
Depth of surface casing below ground.	39"
I.D. of riser pipe.	2"
Type of riser pipe, Upper: Schedule 40 PVC Lower: #316 stainless steel.	
Depth, top of stainless steel:	60'
Diameter of borehole.	7"
Type of backfill: Cement with 10 bentonite.	
Depth, top of seal.	77'
Type of seal: Bentonite pellets.	
Depth, bottom of seal.	82'
Type of sand pack: Fine to medium sand.	
Depth, top of sand pack.	82'
Depth, top of screened section.	697.1 / 90'
Type of screened section: #316 S.S.	
Describe openings. 0.001"	
I.D. of screened section.	2"
Depth, bottom of screened section.	697.1 / 100'
Depth, bottom of plugged blank section.	100' - 2½"
Depth, bottom of sand column.	100' - 2½"
Type of backfill below observation pipe.	Bentonite pellets
Depth of hole bottom.	105'

Industrial Waste Management Facility
Warren County, Missouri

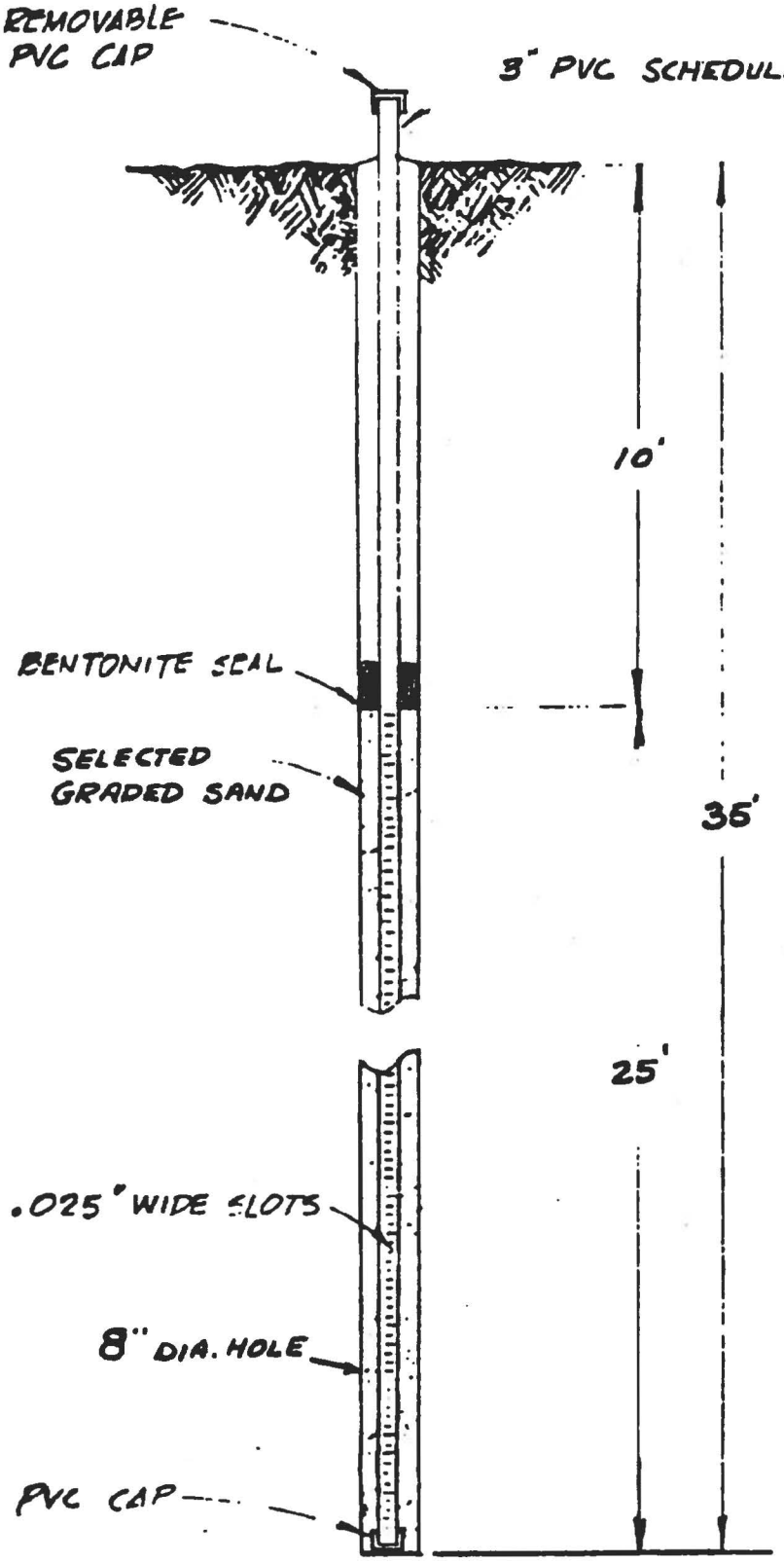
GROUND WATER MONITOR WELL SCHEMATIC

Brucker & Associates Consulting Engineers — Brentwood, Mo. February 1988

ATTACHMENT 6

General Well Construction Diagram P Series Wells

from file #1



PIEZOMETER

REITZ & JENS, INC.
CONSULTING ENGINEERS
111 SOUTH MERAMEC AVENUE
ST. LOUIS, MISSOURI 63105

FEBRUARY 1977

FIG. 2